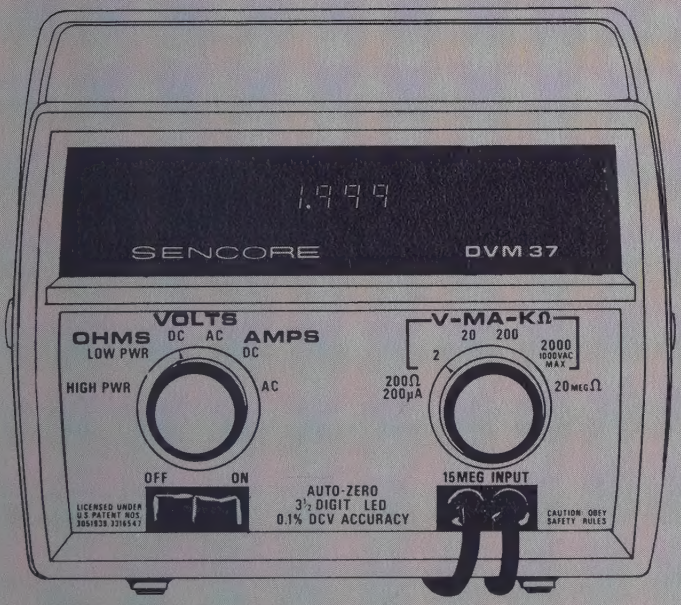
DVM37

DIGITAL MULTIMETER

OPERATION AND APPLICATION MANUAL



SENCORE

3200 Sencore Drive, Sioux Falls, South Dakota 57107

WARNING

PLEASE OBSERVE THESE SAFETY PRECAUTIONS

There is always a danger present when testing electronic equipment. Unexpected high voltages can be present at unusual locations in defective equipment. Become familiar with the equipment you're working with, and observe the following safety precautions.

1. **Never exceed the limits of this instrument** as given in the specifications section and the additional special warnings in this manual.
2. **A severe shock hazard can result** if the chassis of the equipment being serviced is tied to the "hot" side of the AC Line. An isolation transformer should always be used with this equipment. Also, be sure that the top of your workbench and the floor underneath it are dry and made of non-conductive material.
3. **Remove the circuit power before making connections** to high voltage points. If this cannot be done, be sure to avoid contact with other equipment or metal objects. Place one hand in your pocket and stand on an insulated floor to reduce the possibility of shock.
4. **Discharge filter capacitors** before connecting test leads to them.
5. **Be sure your equipment is in good order.** Broken or frayed test leads can be extremely dangerous and can expose you to dangerous voltages.
6. **Remove the test leads** immediately after the test has been completed to reduce the possibility of shock.
7. **Do not work alone** when working on hazardous circuits. Always have another person close by in case of an accident. Remember, even a minor shock can be the cause of a more serious accident, such as falling against the equipment, or coming in contact with high voltages.
8. **Improper Fuse(s) Void Warranty.** Fuses are for your protection, so always replace fuses with proper type and current rating. The proper fuse type description is marked near the fuse holder and in the instruction manual. Always:
   a. **Be sure you are replacing the right fuse.** On units with more than one fuse, be sure you are placing the proper fuse value in the fuse holder.
   b. **Keep spare fuse storage area stocked.** Always have proper sized fuse stored in the spare fuse area on the back of the unit. If you use the spare fuse, always put a new spare of the proper value in the holder.
   c. **Have the proper size replacement fuse in stock.** With each new instrument, be sure to update your fuse inventory with any special value fuses your instrument may require.
   d. **Avoid situations that will blow the fuse.** When a protection fuse blows, note what caused the fuse failure. Prevent future fuse failures by following proper measuring procedures.

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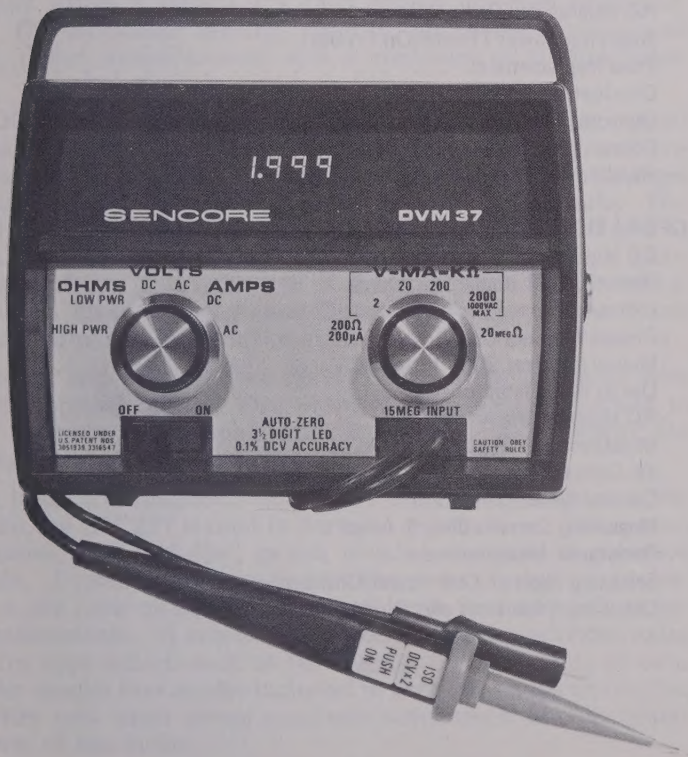

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DESCRIPTION

INTRODUCTION

The electronics servicing field is becoming more sophisticated and is requiring more precise readings. The advent of integrated circuits means more and more complex circuits are being found in locations requiring portable, rugged meters with very high accuracy. Sencore has become known for its line of dependable, rugged digital multimeters. Of these, the DVM37 offers the best combination of accuracy and rugged-portability in a meter that can be trusted anywhere.

FEATURES

The DVM37 offers a large (.3") LED display for high resolution readings. The automatic zeroing, polarity, and decimal placement offer fast, direct measurements with a minimum of reading interpretation.

The .1% DC voltage accuracy, backed by Sencore's 15 Megohm input impedance, offers the best combination of high accuracy and low circuit loading for dependable measurements. A total of 28 ranges allows measurements in either low-level or high-level circuits. The 4 AC and 4 DC Voltage ranges allow measurements from 1 mV to 2000 VDC or 1000 VAC. The 5 AC and 5 DC current ranges allow measurements from .1 uA through 2 Amps without the use of external shunts. Plus, 5 High Power Ohms and 5 Low Power Ohms ranges allow complete in-or out-of-circuit resistance measurements.

The reliability and safety of the DVM37 are further increased with the use of a special probe. This probe is permanently attached to eliminate dangerous lead connectors when using the DVM37 for high voltage or current measurements.

Since the leads are attached, there is no chance of misplacing the probe when the DVM37 is used in portable applications. The special probe features a "Touch-On" switch which is designed to conserve battery life. Power is only applied to the meter during a measurement when the push-on button is pressed, with no battery drain between measurements. A second switch on the probe provides extra isolation for applications such as DC Voltage measurements in oscillators. The special fuse holder included in the probe adds protection to the entire unit since severe overloads never reach the electronic components of the meter.

The DVM37 offers the highest protection against accidental electrical or mechanical abuse possible with the current state-of-the-art. The Cycolac® case and special shock-mounted, computer-grade printed circuit boards make the DVM37 extremely rugged for field use. Electrical protection includes both fuse and diode protection to 2000 Volts on all ranges, backed up with a special spark gap to prevent

damage to any of the solid-state components in case of an overload over 2000 Volts DC.

The DVM37 offers a choice of three power options. Standard "C" cells may be used for disposable battery operation. The second choice is rechargeable Ni-Cad batteries. Since the DVM37 uses standard Ni-Cad "C" cells, there is no need to purchase expensive modifications or custom battery packs when the decision to change to rechargeable operation is made. Finally, the optional PA208 AC Power Adapter allows 110-120 Volt line operation and recharges the Ni-Cad batteries if they are used. (Note: PA208 can only be used with batteries installed into the DVM37.)

SPECIFICATIONS

Note : All accuracies expressed as percentage of reading ± 2 digits, unless otherwise specified.

DC VOLTAGE:	
4 RANGES:	0 to ± 2, 20, 200, 2000 Volts.
ACCURACY:	.1%, except 2000 VDC range = .2%
RESOLUTION:	1 mV on 2V range.
INPUT IMPEDANCE:	15 Megohm (30 Megohm using isolation resistor).
RESPONSE TIME:	1 sec max.
POLARITY:	Automatic negative sign indicator.
ISOLATION:	Built-in 15 Megohm 1%. Isolation resistor in probe. Can also be used for X2 multiplication, extending ranges to 4, 40, 400, 2000 Volts. Isolation Accuracy: 1.1%.
AC REJECTION:	60 dB at 50-60 Hz.
MAX INPUT PROTECTION:	2000 Volts (DC + peak) on any range. Internal diode plus spark-gap protection.
AC VOLTAGE:	
4 RANGES:	0 to 2, 20, 200, 1000 Volts.
ACCURACY:	.5% except 1000 VAC range = .75%.
RESOLUTION:	1 mV on 2V range
INPUT IMPEDANCE:	1.5 Megohm shunted by less than 100 pF.
RESPONSE TIME:	2 sec max.
FREQUENCY RESPONSE:	40 Hz-5 KHz @ .5 dB.
AC CONVERSION:	RMS reading, average detecting.
MAX INPUT PROTECTION:	2000 Volts (Peak + DC) or 1400 Volts rms. Internal diode plus spark-gap protection.

DC CURRENT:	
5 RANGES:	0 to ± 200 uA, 2, 20, 200, 2000 mA.
ACCURACY:	.3%
RESOLUTION:	.1 uA on 200 uA range.
VOLTAGE BURDEN:	200 mV, except 250 Mv on 200 mA range and 1.0 V on 2000 mA range.
SHUNT RESISTANCE:	1K, 100, 10, 1, .1 ohm for ranges above.
RESPONSE TIME:	1 sec max.
POLARITY:	Automatic negative sign indicator.
MAX INPUT PROTECTION:	Any input current to 250V (Peak + DC), 2 Amperes max, 250V to 2000V (Peak + DC), internal diode protection of shunt resistors with 2A fast-blow fuse in probe tip.
AC CURRENT:	
5 RANGES:	0 to 200 uA, 2, 20, 200, 2000 mA.
ACCURACY:	1% of reading ± 3 digits.
RESOLUTION:	.1 uA on 200 uA range.
VOLTAGE BURDEN:	200 mV, except 250 mV on 200 mA range and 1.0 V on 2000 mA range.
SHUNT RESISTANCE:	1K, 100, 10, 1, .1 ohm for ranges above.
RESPONSE TIME:	2 sec max.
INPUT PROTECTION:	Any input current to 250V (Peak + DC), 2 Amperes max, 250V to 2000V (Peak + DC), internal diode protection of shunt resistors with 2A fast-blow fuse in probe tip.
RESISTANCE:	
6 RANGES:	0 to 200, 2K, 20K, 200K, 2000K ohms (Low power); 0 to 2K, 20K, 200K, 2000K ohms, 20 Megohms (High power).
ACCURACY:	.2% ± 3 digits, except 20 Meg = .5%
RESOLUTION:	.1 ohm on 200 ohm range.
MAX VOLTAGE APPLIED:	Low Power: 200 mV; High power: 1V.
MAX CURRENT THROUGH UNKNOWN R:	1mA, 100, 10, 1, .1 uA for Lo Power ranges above. 500, 50, 5, .5, .05 uA for Hi Power ranges above.
RESPONSE TIME:	1 sec, except 3 sec on 20 Megohm ranges.
MAX INPUT PROTECTION:	2000 Volts (DC + peak) on all ranges. Diode and 1/16A fuse protection. Fuse located in battery compartment.
GENERAL:	
DISPLAY:	3½ digit, 7 segment, 0.3" red LED
INDICATORS:	Automatic Negative Sign indicator , Automatic Decimal, Automatic Over-range (indicated by flashing "1" with remaining digits blank).

A/D CONVERSION:	Dual Slope method.
SAMPLE RATE:	3 samples per second.
FUSE:	2A fast blow, 3AG type, located in probe tip. 1/16 Amp fast blow, 3AG type, located in battery compartment.
MECHANICAL:	Drop-proof Cycolac® case, completely insulated. Carrying handle/tilt stand. Test leads attached.
SIZE:	7"x5"x4" HWD (17.9x12.8x10.2 cm)
WEIGHT:	2¼ lb. (1.0) Kg)., including batteries.
POWER:	Batteries: Four standard "C" cells Rechargeable: PA208 Power Adapter with four rechargeable "C" cells. AC Line: 115/130 VAC 50/60 Hz when used with PA208 Power Adapter and batteries installed for filtering.

(Specifications subject to change without notice.)

CONTROLS

1.) POWER SWITCH: Applies power to the instrument in ON position. Bypasses the Push-On switch in the probe.

2.) FUNCTION SELECTOR: Selects function desired for measurement.

3.) NEGATIVE SIGN INDICATOR: Indicates potential applied to probe is negative with respect to black common lead in DC Volts or DC Amps function. Blanked on other functions.

4.) DIGITAL READOUT: Bright 3½ digit, seven segment LED (light emitting diode) numerals. Automatic zero on all functions.

5.) DECIMAL INDICATORS: Automatically positioned decimals for direct digital readout. No decimal shown on "2000" ranges.

6.) HI-IMPACT CYCOLAC®CASE: Rugged, breakproof case for extended life in field use. Completely insulated for electrical protection. Contoured hand-sized styling.

7.) HANDLE/TILT STAND: Handle rotates toward back to serve as tilt stand for easy viewing on bench.

8.) RANGE SELECTOR: Selects desired range for measurement.

CONTROLS

(FOLD OUT)

PREPARING FOR MEASUREMENTS

BATTERY INSTALLATION/REPLACEMENT

The DVM37 must have batteries installed whether used portably or used with the optional PA208 AC adapter. The DVM37 requires four "C" cell batteries. These should be alkaline batteries for disposable operation or Ni-Cad batteries for rechargeable operation. The Ni-Cad batteries are recharged (inside the meter) when the DVM37 is operated from the DP208 or 39G90 Power Adapter.

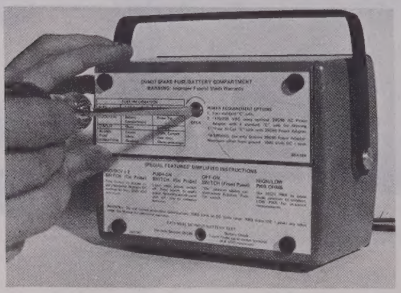

Fig. 2 — Removing the battery compartment cover.

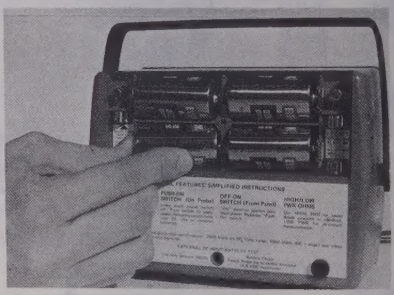

Fig. 3 — Installing four "C" batteries.

To install or replace batteries:

1.) Remove the screw from the battery compartment cover located on the back of the DVM37.

2.) Inspect the battery contacts for signs of corrosion. Remove any corrosion before installing new batteries.

3.) Install four "C" cells as shown. Observe proper battery polarity as indicated by the "+" marks inside the battery compartment.

4.) Insure that proper contact is made to the battery terminals at either end of the battery compartment as well as the spring contacts located between the batteries.

5.) Replace the cover and tighten the battery compartment screw.

BATTERY TEST

The condition of the batteries may be tested at any time using the DC voltage scale of the DVM37. The battery test should produce a reading of 4.8 volts or more for proper operation.

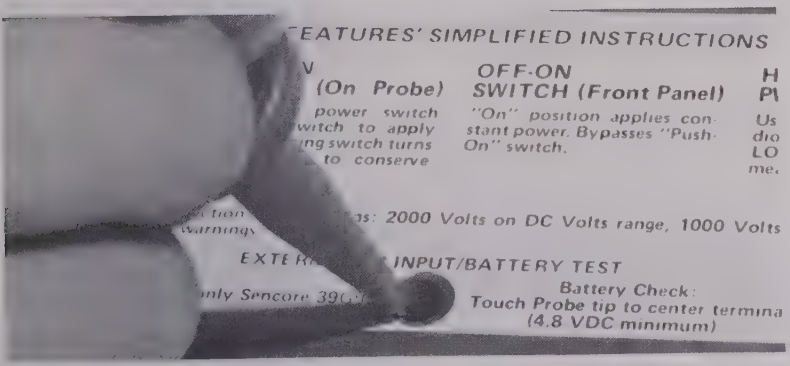

Fig. 4 — Performing battery test by measuring voltage at the AC adapter input jack.

To test the batteries:

1.) Select the DCV function and the 20 volts range of the DVM37. Be sure the meter is turned on.

2.) Touch the test probe to the center conductor of the AC adapter input jack (back of meter).

3.) Read the battery condition on the DIGITAL READOUT. A reading of 4.8 or greater indicates the batteries are good. If the reading is below this level, the batteries should be replaced or recharged.

AC OPERATION (OPTIONAL)

WARNING: Only a specially designed supply such as the Sencore PA208 should be used to operate the DVM37. The lower breakdown voltage of adapters designed for tape recorders or calculators may cause damage to the meter when high voltages are being measured.

The DVM37 may be operated from the AC line with the use of the optional PA208 Power Adapter. The PA208 will allow AC operation

when used with standard batteries, and will also recharge Ni-Cad batteries if they are installed.

The PA208 will provide enough current to operate the DVM37 unless the batteries are totally discharged. If rechargeable batteries are allowed to totally discharge, the PA208 should be connected to the DVM37 (with the DVM37 turned off) for two to three hours to bring the battery voltage back into the operating range.

NOTE: Batteries must be installed for filtering when the PA208 Power Adapter is used. This provides the added convenience of battery operation whenever the PA208 is unplugged from the DVM37.

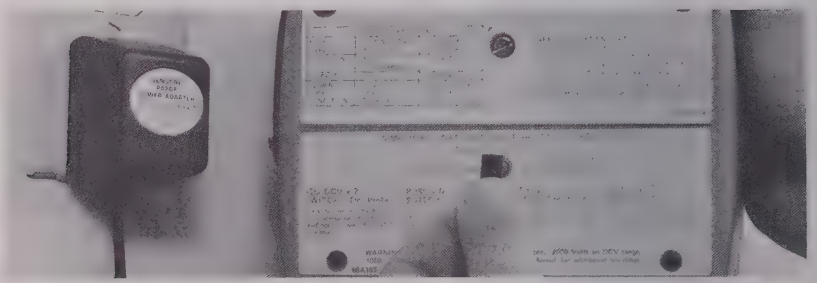

Fig. 5 — Connecting the PA208 Power Adapter for AC power operation.

To use the PA208 Power Adapter:

1.) Install the desired batteries as explained under "Battery Installation/Replacement."

2.) Connect the output cable of the PA208 to the AC ADAPTER INPUT JACK at the back of the DVM37.

3.) Connect the PA208 to a 105-130 VAC outlet.

HINT: Completely discharged Ni-Cad batteries require 10-14 hours to recharge. If the PA208 is connected to an outlet on 24-hour service, the batteries will completely recharge overnight so the meter will be ready for the next day's service.

NOTICE: The PA208 Power Adapter replaces the older 39G90 adapter. The PA208 may be used to power either 6 or 9 Volt Sencore instruments. The 39G90 (6 Volt only) may be used in place of the PA208 by following these same instructions.

APPLYING POWER (TOUCH-ON PROBE)

The DVM37 has two power switches. The first provides continuous operation, and the second provides battery-saving "touch-on" operation.

For continuous operation:

1.) Turn the POWER SWITCH on the DVM37 front panel to the "ON" position.

2.) When the front-panel switch is used, the TOUCH-ON SWITCH on the probe is bypassed.

Fig. 6 — Continuous operation with front panel switch on.

Fig. 7 — Battery-saving operation by pressing switch in the probe.

To conserve batteries:

1.) DO NOT turn the POWER SWITCH on the front panel "ON".

2.) Press the TOUCH-ON SWITCH on the probe while a measurement is being made. Power will be applied to the DVM37 as long as the switch is depressed.

3.) Release the TOUCH-ON SWITCH at the conclusion of the measurement. The DVM37 will now turn off, resulting in no battery drain between measurements.

FUSE REPLACEMENT

The DVM37 has two protection fuses. One is located inside the probe, and the second is located in the battery compartment. Spare fuses for both fuse locations are located inside the battery compartment.

The 2A fast blow fuse located in the probe protects the AC and DC current ranges. The 1/16 Amp fuse located inside the battery compartment protects the Ohms ranges.

WARNING: Improper fuses void warranty. Replace the fuses only with the types specified. Never use a slow-blow fuse or one with a larger current rating than specified.

To replace the Ohms protection fuse: (disconnect probe from circuit.)

1.) Remove the battery compartment cover.

2.) Remove the defective fuse from the fuse holder.

3.) Remove the spare 1/16 Amp fast blow fuse from the storage area next to the fuse holder.

4.) Check the spare fuse to be sure it is the proper value and type.

5.) Install the spare fuse in the fuse clip.

6.) Replace the spare fuse removed from the battery compartment with a new one as soon as possible.

7.) Replace the battery compartment cover.

Fig. 8 — Ohms protection fuse location in battery compartment.

Fig. 9 — Current protection fuse location in test probe.

Some brands of 1/16th Amp fuses have a high internal resistance. This resistance can affect the accuracy of the Ohms functions if the fuse resistance is over 7 Ohms.

Generally, the 3AG, 1/16th Amp fast-blow Littlefuse replacement is suitable for direct replacement. Other brands of fuses (for example Buss) may offer resistances as high as 15-20 Ohms. Before other brands are used, their resistance should be checked.

NOTE: Even though a high resistance fuse changes the accuracy of the meter, questionable fuses may be checked with a high-resistance

fuse in the meter. The accuracy of the 200 Ohms range with a high resistance fuse installed is typically 5% low. This is sufficient accuracy for testing questionable fuses.

If there is any difficulty in obtaining 1/16th Amp fuses locally, they may be purchased directly from the Sencore Parts Department. Details on ordering these fuses are found in the parts list printed on the schematic diagram accompanying your DVM37.

To replace the current protection fuse

1.) Unscrew the red portion of the test probe.

2.) Remove the defective fuse from the probe.

3.) Remove the spare 2 Amp fast blow fuse from the battery compartment.

4.) Check the spare fuse to be sure it is the proper value and type.

5.) Install the spare fuse in the probe tip and replace the red portion.

6.) Replace the spare fuse removed from the battery compartment with a new one as soon as possible.

OVERLOAD PROTECTION

The DVM37 offers the highest protection available in a portable meter. All ranges are protected to 2000 Volts (DC + peak AC) with a combination of diode protection and back-up fuse protection. In addition, the circuitry is protected against instantaneous peaks of more than 2000 Volts with a special spark gap.

NOTE: The spark gap protects the DVM37 from some overloads over 2000 Volts. Care should be taken to prevent such overloads, however, since there is a chance of damaging the meter, spark gap, or the circuit under test if the spark gap is allowed to operate for an extended period of time.

To prevent possible meter damage or the annoyance of changing protection fuses, use care in every measurement. Observe the following procedures for safe operation:

1.) Do not measure over 1000 VAC (1400 Volts peak) or 2000 Volts DC.

2.) Make sure the power is removed from any circuit before a resistance check is made.

3.) Never attempt to measure the current of a power supply by placing the DVM37 across the supply or the circuit load.

4.) Observe all safety precautions and warnings in the manual and on the meter's back panel.

OVERRANGE INDICATION

The DVM37 provides a positive indication of an out-of-range reading by (1) blanking the three right-hand digits, and (2) flashing the numer "1" in the left digit. This indication is the same as an analog meter that has been "pegged" full scale.

Fig. 10 — Overrange indication shows as a blinking "1" with all other digits blank.

When measuring a voltage or current, an overrange indication tells you to step up to the next range. *If the meter is already in the top range, the meter should immediately be removed from the circuit, as the signal exceeds the range of the DVM37.*

When an overrange indication is present on a resistance test, it indicates "infinity" ohms. The meter should be placed in a higher ohms range. If all ohms ranges show erratic readings the OHMS PROTECTION FUSE should be checked. See "Fuse Replacement" for details.

An important feature of the type of overrange indication used in the DVM37 is that the battery drain is reduced by almost 50% when the 3 digits are blanked. This means that the battery life is conserved between readings if a series of resistance measurements is made.

CONNECTING COMMON ABOVE GROUND

WARNING: When the common lead is floated above ground, use extreme caution to prevent contact with either meter lead. All overload specifications must be observed in reference to the potential between the two meter leads.

The common lead of the DVM37 may be connected to a potential above common ground (for example, between two phases of a three-phase wiring system) *provided the following maximum offset values are observed;*

1.) When operating with batteries (no connection to the PA208 Power Adapter) the DVM37 may be safely floated 2000 Volts above reference ground.

2.) When operating with the PA208 Power Adapter connected, the DVM37 may be safely floated 1000 Volts above reference ground.

READING THE DISPLAY IN DIRECT SUNLIGHT

If the DVM37 display is exposed to direct sunlight or other intense light, it will appear to indicate "8888" because of reflected light on the LED segments. Simply shade the readouts for viewing under these lighting conditions.

OPERATION AND APPLICATIONS

DC VOLTAGE MEASUREMENTS

The DVM37 allows measurements up to 2000 Volts DC or a resolution as low as 1 mV (.001 Volts). The high (.1%) DC accuracy allows measurements of critical voltages. Remember, however, that the most accurate readings occur when the reading is between full scale and 1/10 of full scale (for example between .200 and 1.999 Volts on the 2 Volt scale). The reason for this, of course, is that any digital meter has an "uncertainty factor" due to the conversion from an analog (continuously variable) input to a digital (1999 discrete steps) output. The DVM37's accuracy is within ±2 counts. This means that the reading of a 1.000 Volt input may read within .997 and 1.003 when you include the .1% ±2 counts. When the reading is less than 1/10th of full scale, this uncertainty factor begins to add to the .1% accuracy factor.

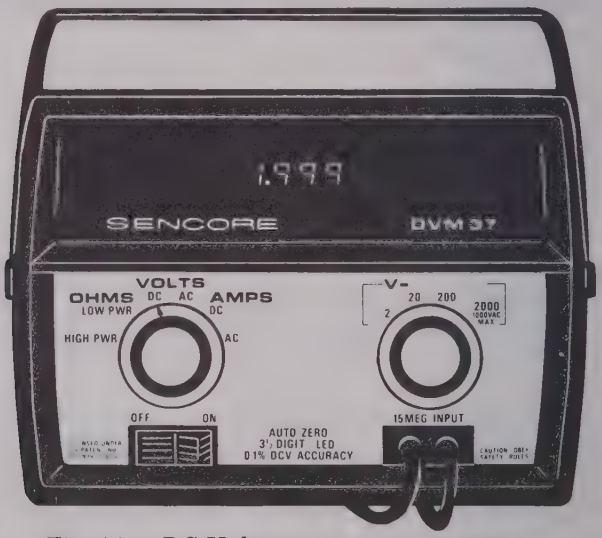

Fig. 11 — DC Voltage measurement set-up.

To measure a DC voltage:

1. Select the DC VOLTS function with the FUNCTION SWITCH.

2. Select the desired range for the voltage to be measured with the

RANGE SWITCH If the voltage is unknown, start with the 2000 Volt range and step down in range until the desired resolution is obtained.

3. Connect the test leads to the test point to be measured.

4. Supply power to the DVM37 using either the front panel POWER SWITCH or the TOUCH-ON switch on the probe.

5. Read the voltage on the DIGITAL READOUT. Polarity will automatically be indicated with respect to the negative lead.

REDUCING DC RANGE SWITCHING

The DVM37 probe is equipped with a special DCV X2 switch. This switch divides the input voltage in half before it is applied to the meter. This switch may be used to reduce range switching in many applications.

For example, a reading of 2.100 Volts would normally produce an overrange indication on the 2 Volt DC function. Depressing the DCV X2 switch will result in a reading of 1.050 without the need of changing the RANGE SWITCH. The reading is still accurate to 1%, which should be sufficient for most applications. The resulting readout from the DIGITAL READOUT is simply multiplied by 2 to obtain the actual voltage at the test point.

WARNING: The switch contacts used in the DCV X2 switch are rated at 2000 Volts. Do not attempt to use the DCV X2 switch to increase the voltage capabilities of the DVM37 beyond the maximum 2000 Volt rating.

NOTE: For maximum accuracy in test points requiring the .1% accuracy of the DVM37, the DCV X2 switch should not be used.

INCREASING INPUT IMPEDANCE

The chance of inaccurate readings due to circuit loading caused by the DVM37 is very low due to the 15 Megohm input impedance. If even less loading is required, the DVM37 offers two options:

Fig. 12 — Pressing "ISO" switch increases input impedance to 30 Megohms.

30 MEGOHM INPUT IMPEDANCE: The DCV X2 switch increases the input impedance to 30 Megohms with a reading accuracy of 1% when depressed. Remember to multiply the reading of the DIGITAL READOUT by 2 for the actual circuit voltage.

1500 MEGOHM INPUT IMPEDANCE (optional): The input impedance may be increased by 100 times by using the optional HP200 High Voltage Probe as an isolation resistor. The accuracy of the reading will now be within 2%.

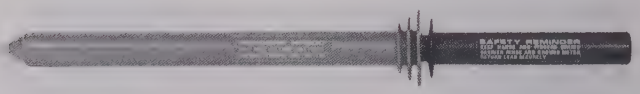

Fig. 13 — Use of the HP 200 High Voltage probe increases input impedance to 1500 Megohms.

To use the HP200 High Voltage Probe to increase input impedance:

1. Slip the HP200 over the standard DVM37 input probe.

2. Select the DC VOLTS function and make your measurement through the HP200 probe.

3. Multiply the resulting DIGITAL READOUT by 100 for the actual voltage.

The use of the HP200 provides a resolution of 0.1 Volts (100mV) on the 2 Volt scale.

CIRCUIT ISOLATION

There are some circuits that may be affected by the input capacitance of a meter. This capacitance is due to the meter input circuits and the test leads which form a small value capacitor connected in parallel with the circuit capacity. The input capacitance may be great enough to cause a circuit such as an oscillator to stop operating. This results in voltages that differ from the schematic diagram. The ISO-DCV X2 SWITCH isolates this input capacitance. The additional 15 Megohm isolation resistor connected in series with the DVM37 test leads effectively isolates the meter and lead capacitance from the circuit under test, allowing accurate measurements. Remember to multiply the results of the DIGITAL READOUT by 2 for the actual DC voltage when the isolation switch is used.

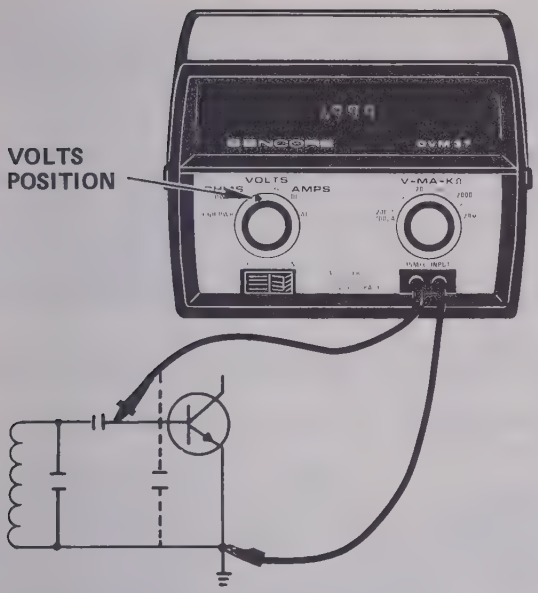

Fig. 14 — Test lead capacitance (dashed line) parallels the circuit and may change the oscillator frequency. "ISO" switch on probe isolates the test lead from the circuit to allow accurate DC testing.

MEASURING OVER 2000 VOLTS DC

The use of the optional HP200 50 KV High Voltage Probe allows DC voltages as high as 50,000 volts to be safely measured. The reading on the DVM37 is simply multiplied by 100 (with a 2% accuracy) by adding two zeros to the meter readout.

WARNING: Do not attempt to perform any high voltage testing until you have completely read and understood the following warnings and instructions:

1. **Never attempt to measure more than 2000 volts without the use of the HP200 High Voltage Probe.** To do so may (a) damage the DVM37, (b) damage the equipment under test, and/or (c) cause a severe shock hazard to the operator.

2. **If the common lead should become detached** during a high voltage measurement, immediately remove power to the circuit under test. **Do not touch the lead, the meter, or the HP200 until the power has been removed,** as there is a possibility of a severe shock hazard. Before continuing with the test, be sure the DVM37 is functioning properly.

3. **If the DVM37 probe should become detached from the HP200,** immediately remove power to the circuit under test. **Do not touch the HP200** until the high voltage has discharged, as there is the possibility of a severe shock hazard.

4. **If the HP200 must be held during a test,** do so with extreme caution. Hold the probe only by the black portion behind the discs. Be sure the ground connection and probe are firmly attached.

5. **Remove power before disconnecting the HP200 from the circuit.**

To measure a voltage over 2000 Volts:

1. REMOVE POWER from the equipment in which the high voltage is to be measured.

Fig. 15 — The DVM37 probe is inserted into the black portion of the HP200 50KV High Voltage Probe.

2. Plug the DVM37 test probe into the back of the HP200 probe. *BE SURE THAT THE PROBE TIP IS SECURELY SEATED.*

3. Select the 2000 VOLTS DC function of the DVM37.

4. SECURELY ATTACH the black common lead from the DVM37 to the ground, chassis, or common point of the high voltage circuit to be measured. *BE SURE THAT THIS LEAD CANNOT BECOME DETACHED DURING THE HIGH VOLTAGE MEASUREMENT.*

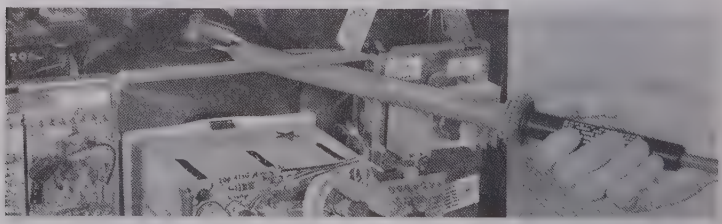

Fig. 16 — Measuring high voltage to 50KV using the HP200 High Voltage Probe.

5. Connect the HP200 to the high voltage point to be measured so that the probe DOES NOT HAVE TO BE HELD during measurement. If this is not possible, hold the probe only by the black handle portion for safety, as shown.

6. Apply power to the equipment under test.

7. Multiply the readout of the DVM37 by 100 to obtain the value of the high voltage being measured. For example, a reading of 300 indicates a voltage of 30,000 Volts.

8. REMOVE POWER from the equipment under test before detaching the HP200 and the common lead.

USE AS NULL DETECTOR

The high resolution of a digital meter allows fast and accurate settings of controls requiring a null setting. If the control needs to be "roughed in," the fastest method is to ignore the last digit. This now gives a reading with about the same resolution as an analog meter.

For a very precise adjustment, the full 3 1/2 digit resolution capability that the DVM37 provides is used. In applications such as bridge circuits, the null can be monitored by means of the polarity indicator. Any slight change from a 000 (nulled) reading will show as a change in polarity or an increase in the reading of the DIGITAL READOUT.

AC VOLTAGE MEASUREMENT

> WARNING: Do not apply more than 1000 Volts RMS (1400 Volts peak) to the DVM37. Higher voltages may cause damage to your meter.

To measure an AC voltage:

1. Select the AC VOLTS function with the FUNCTION SWITCH.

2. Select the desired range for the voltage to be measured with the RANGE SWITCH. If the voltage is unknown, start with the 1000 Volt range, and step down in range until the desired resolution is obtained.

3. Connect the test leads to the test point to be measured.

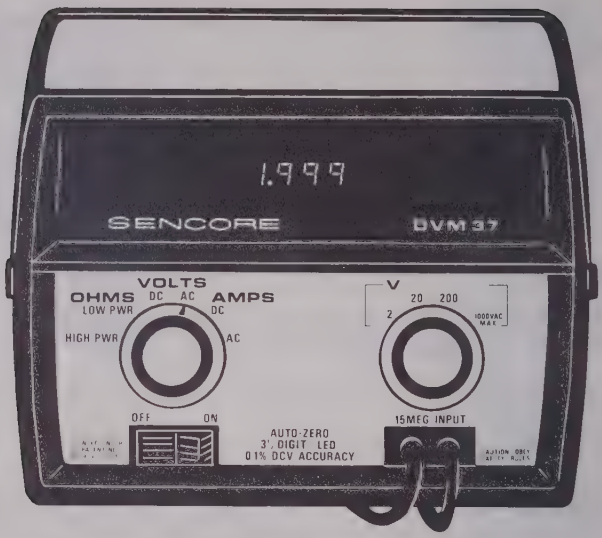

Fig. 17 — AC Voltage measurement set-up.

4. Supply power to the DVM37 using either the front-panel POWER SWITCH or the TOUCH-ON switch on the probe.

5. Read the voltage on the DIGITAL READOUT.

NOTE: The DCV X2 switch should not be used when making AC voltage measurements.

MEASURING RF SIGNALS

The shielded design of the DVM37 makes it ideal for communic tions servicing. The use of the Sencore DP209 RF demodulator pro allows RF signal measurements from .01-50 Volts RF in a frequen range of 8-250 MHz. Complete instructions on the use of the DP as an RF probe are supplied with the probe.

dB CONVERSIONS

Some measurements require that audio signals expressed in d 0 dB reference for audio circuits is 1 milliwatt fed to a 60 load. This represents a signal of .775 Volts AC. A voltage converted to a dB measurement by using an electronic calc slide rule. The conversion formula is:

$$dB = 20 \text{ Log } \frac{\text{AC Reading}}{.775}$$

The following chart may be used for a conversion to dB. To use the chart, simply locate the meter reading on the bottom scale, and locate the dB equivalent on the left scale. Note that this chart applies to the 2 Volt range.

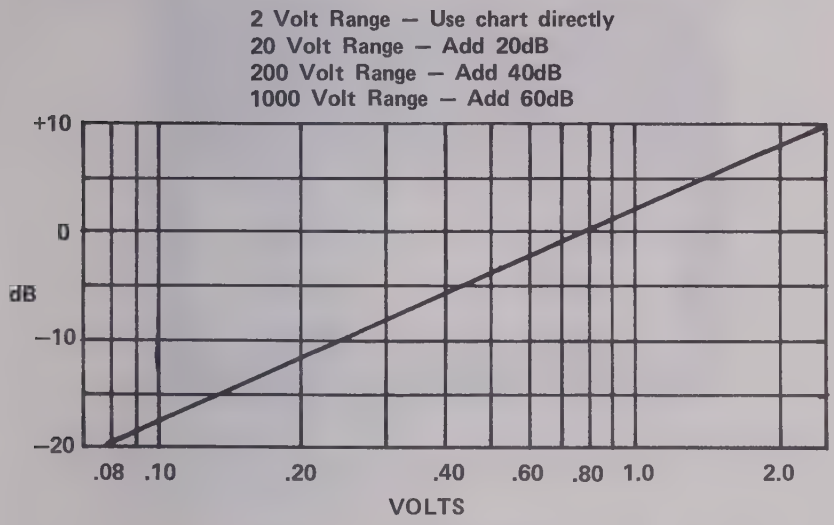

Fig. 18 — Chart for converting AC Voltage into dB.

The table may be used with the other AC scales by adding the dB conversion listed in the table for the other ranges. Simply ignore the decimal on the DVM37 readout, obtain the dB number from the chart, and then add the proper correction amount.

For example, a reading of 23 Volts (taken on the 200 Volt range) is read as ".23" from the chart. This gives us -10.5. Adding 40 dB results in a dB reading of 29.5 dB. (40 - 10.5 = 29.5)

CURRENT MEASUREMENTS

The DVM37 provides 5 AC and 5 DC current ranges from 200 uA to 2 Amps full scale. Current measurements should always be made with the meter in series with the power supply and the load. This usually requires the power supply line to be broken and the meter connected between the supply and the load. Meter connections should always be made without power applied to the circuit under test. The power should also be removed before the meter is removed from the circuit.

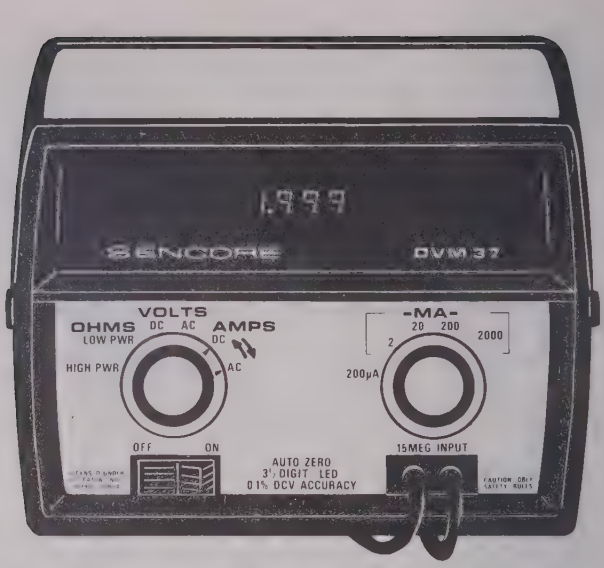

Fig. 19 — DC or AC Current measurement set-up.

To measure an AC or DC current:

1. Remove the power to the circuit under test.

2. Select either the AC or DC AMPS position on the FUNCTION SWITCH.

3. Select the range of current desired for the test to be made. *NOTE: 2000 mA IS 2 AMPS FULL SCALE.*

4. Connect the meter leads in series with the current path of the circuit under test.

5. Apply power to the circuit under test, and read the resulting current on the DIGITAL READOUT. The polarity of a DC current will be automatically displayed with respect to the black common test lead. There will be no polarity indication if the AC current function is selected.

NOTE: The life of the switch contacts can be prolonged if range switching is avoided while measuring high currents. When using the high current ranges, turn the power to the circuit under test off before switching ranges.

MEASURING CURRENT OVER 2 AMPS

The DVM37 may be used to measure currents up to 20 Amps with the use of an external .1 ohm shunt. Instructions for the construction of such a shunt follow these operating instructions.

To measure currents over 2 Amps:

1.) Connect the shunt in parallels with the DVM37 input leads.

2.) Select the DC VOLTS function to read DC current, or the AC VOLTS function to measure AC current.

3.) Set the RANGE SWITCH to the 2 VOLT position.

4.) Remove power from the circuit under test and connect the shunt (and meter) in series with the circuit to be measured.

5.) Apply power to the circuit under test.

6.) Note the reading on the DIGITAL READOUT and multiply the reading by 10. For example, a reading of 1.000 Volts indicates a current of 10.00 Amps.

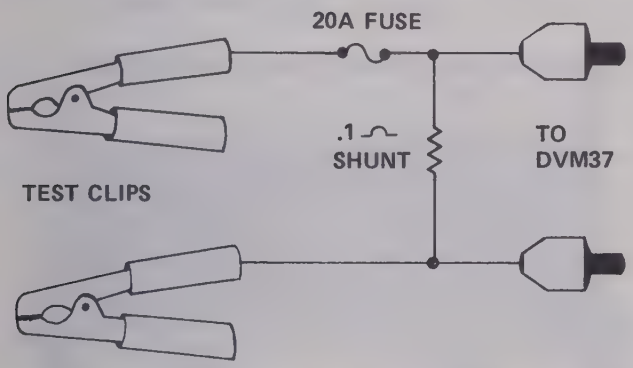

Fig. 20 — Construction of external shunt to measure current from 2 to 20 Amps.

To build the 20 Amp shunt:

Use a .1 Ohm resistor capable of carrying 20 Amps. You may construct this resistor by using 15'8"of #18 AWG copper wire, or 7 7/8" of #20 AWG resistance wire (alloy 45, Sencore part number 42E11). Resistance wire does not change value as the shunt temperature increases during extended measurements.

A 20 Amp fast blow fuse should be connected in series with the shunt for overload protection as shown in the schematic. Use heavy test clips and connectors to insure proper current carrying capability. Allow adequate ventilation for the heat dissipated from the shunt if more than momentary measurements are to be made.

RESISTANCE MEASUREMENTS

The DVM37 offers a choice of high or low power resistance measurements. The high power scales provide a maximum test voltage of 1 volts, and the low power scales provide a maximum voltage of .2 Volts, when a resistor which has a resistance less than the full-scale value is connected across the test leads. The low power ohms function is designed to prevent conduction of solid-state devices for in-circuit measurements. More details are given in the "Selecting High or Low Power Ohms" section.

SPECIAL NOTE:The 200 Ohm range functions on Low Power Ohms only. Selecting the High Power Ohms function with the 200 Ohms range may result in a reading approximately half of the actual measured resistance. Likewise, the 20 Megohm range is designed for use on the High Power Ohms range only. The use of the Low Power 20 Megohm range will result in questionable readings.

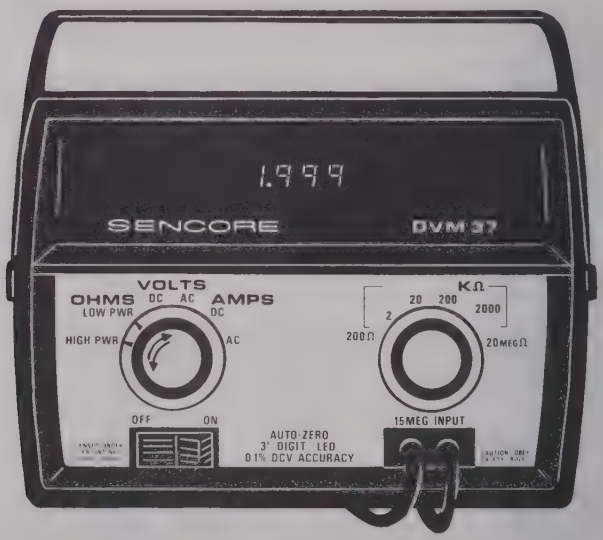

Fig. 21 — Resistance measurement set-up.

To measure a resistance:

1.) Select either the HIGH PWR or LOW PWR OHMS position on The FUNCTION SWITCH.

2.) Select the desired range with the RANGE SWITCH. *Note: The four ranges enclosed in the brackets on the front panel provide a direct readout in kilohms. Remember to multiply these readings by 1000 if the resistance is to be read as ohms.*

3.) REMOVE POWER to the component to be tested. Discharge any filter capacitors.

4.) Connect the test leads of the DVM37 across the component to be measured.

5.) Read the resulting resistance on the DIGITAL READOUT.

6.) If the DIGITAL READOUT shows an overrange condition (a flashing "1" with the last three digits blanked) move the RANGE SWITCH to the next higher range. If the overrange indication is present on the 20 Meg range, an open circuit is indicated.

Note: The 20 Meg range may take several seconds to change from the overrange condition due to the extremely large time constant of the resistor under test. The settling time of this scale can be reduced by momentary shorting the test leads together before the measurement is made.

SELECTING HIGH OR LOW POWER OHMS

Generally, the Low Power Ohms function has been designed for use when in-circuit resistance tests are desired, and the High Power Ohms function is for general resistance testing.

Many types of servicing literature include resistance charts showing the resistance paths of key components to ground. These charts are especially helpful in locating shorted components. Most of these charts were made with a Low Power Ohmmeter. To duplicate the test results, the Low Power Ohms function must be used for testing.

The sample chart shown uses a high power meter for the first measurements, and a low power meter for the remainder of the chart. The DVM37 allows both types of measurements to be made.

RESISTANCE MEASUREMENTS

ITEM	P.N.1	P.N.2	P.N.3	P.N.4	P.N.5	P.N.6	P.N.7	P.N.8	P.N.9	P.N.10	P.N.11	P.N.12	P.N.13	
Q1	27 Ω	5meg *	NC	160 Ω *	NC	2.3meg	2.3meg	9000 Ω*	1129 Ω	100 K	4.8K	15 Ω		
Q2	4590 Ω	393 K	62 Ω *	45 K	24 Ω	22 Ω	560 Ω	110 Ω**	12 K *	6400 Ω*				
Q3	3500 Ω *	329 K	11K *	11 K *	15 Ω	33 K *	390 Ω	390 Ω	1.7meg					
Q4	74 Ω	63 K	197 Ω	197 Ω	41K *	197 Ω	8200 Ω	0 Ω	9200 Ω	40 K *	9200 Ω	25 Ω		
Q5	NC	34 Ω	NC	0 Ω	11.5 Ω	NC	34 Ω *	NC	NC					TOP CAP 600 K
Q6	NC	1 Ω	2500 Ω	NC	2.6 meg	NC	25 Ω	26 Ω						TOP CAP 2 Ω *
Q8	1	4000 Ω	4200 Ω	5meg*	1.6meg *	4200 Ω*	330 K *	NC	0 Ω	NC	4200 Ω*	330 K *	1.3meg *	PIN 4 FET

MEASUREMENTS BELOW TAKEN WITH METER HAVING .08V MAX BETWEEN PROBE TIPS

ITEM	E	B	C	ITEM	E	B	
Q1	520	5000 Ω	1500 Ω	Q12	12 K	11 K	11 Ω
Q2	5,000 Ω	2500 Ω	1530 Ω	Q13	323 Ω	7500 Ω	830 Ω
Q3	5K	2000 Ω	750 Ω	Q14	160 Ω	10 K	490 Ω
Q4	240	6400 Ω	2700 Ω	Q15	956 Ω	3900 Ω	150 Ω
Q5	560 Ω	1.5K Ω	1.5K Ω	Q16	0 Ω	14meg *	10 K
Q6	1.8K Ω	2.2 K	6.8K Ω	Q17	4.8K Ω	11meg *	900 Ω
Q7	352 Ω	4.5K Ω	5300 Ω	Q18	680 Ω	4200 Ω	560 Ω
Q8	100 Ω	910K *	1600 Ω	Q19	480 Ω	3000 Ω	680 Ω
Q9	290 Ω	1.1K Ω	4.8 *	Q20	380 Ω	3200 Ω	1800 Ω

—Courtesy Howard W. Sams & Co.

Fig. 22 — Chart from service literature showing typical in-circuit resistance readings taken with low power ohmmeter.

The High Power Ohmmeter also allows the out-of-circuit front-to-back resistance testing of transistors and diodes.

CHECKING TRANSISTORS AND DIODES

Front-to-back resistance ratios of diode and transistor junctions can be measured using the DVM37 HIGH POWER OHMS function. A good diode junction will be indicated by an overrange indication with the leads connected in one direction, and a resistance reading with the leads reversed.

A shorted junction will show a low resistance reading in both directions, and an open junction will show an overrange indication in both directions.

The forward resistance reading differs slightly from the results of a pointer-type analog meter. The DVM37 will show approximately twice the voltage drop across the junction, expressed in millivolts by ignoring the decimal. This means that the reading will be about the same on each scale of the OHMS function. Differences in these readings are due to different test currents. This characteristic allows the DVM37 to be used for determining the type of semiconductor material.

Silicon junctions will generally have a voltage drop greater than .6 volts. This voltage is determined by ignoring the decimal and reading

the voltage drop in millivolts. For example, the reading of a silicon junction will be greater than 120.0 Kilohms on the 200 Kilohm scale, 12.00 Kilohms on the 20 Kilohm scale, etc. Germanium junctions will generally have a voltage drop of .3 volts (600 readout) or less.

The currents used for these tests are limited to safe levels to prevent damage to the device under test. To determine the polarity of the device, the probe is positive, and the common test lead is negative.

READING SMALL RESISTANCES

It is normal for the DVM37 to show a reading of 0.4 Ohms or less on the 200 Ohm Lo Power range. The reason is the high sensitivity of the meter will read the resistance of the test leads and switch contacts. If it is necessary to read a resistance of less than 1 Ohm, use the following procedure:

1. Short the test leads together and note the test leads' resistance.

2. Connect the test leads to the resistor to be measured.

3. Subtract the test leads resistance from Step 1 from the reading in Step 2 for the actual resistance reading.

For Example: With the leads shorted, the reading is 0.3. With a resistor connected, the reading is 1.2. Subtract 0.3 from 1.2 for a reading of 0.9 Ohms.

SERVICE AND WARRANTY

You have just purchased one of the finest Digital Multimeters on the market today. The Sencore DVM37 has been inspected and tested twice at the factory and has passed a rugged use test by our Quality Assurance Department to insure the best quality instrument to you. If something should happen, the DVM37 is covered by the exclusive 100% Made Right Lifetime Guarantee as explained on the warranty policy enclosed with your instrument.

Instruments to be serviced should be returned to the Factory Service Department by UPS if possible. Parcel Post should only be used as a last resort. Instruments should be packed with the original packing material or equivalent, and double boxed to insure safe arrival at the factory. The display carton is not an acceptable shipping container. When returning an instrument for service, be sure to state the nature of the problem to insure faster service.

If you wish to repair your own DVM37, we have included a schematic and parts list. Any of these parts may be ordered directly from the factory Service Parts Department.

We reserve the right to examine defective components before an in-warranty replacement is issued.

Sencore Service Department
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